What is Claimed:

1. A method for producing a mixture of chlorine and chlorine dioxide comprising the steps of:

introducing an aqueous solution of an alkali metal chlorate with an inorganic acid into a reactor and permitting at least 90% by volume of said alkali metal chlorate to react with said inorganic acid to produce gaseous chlorine, chlorine dioxide and steam in a gas head space of said reactor;

removing said gaseous chlorine, chlorine dioxide and steam from said reactor; and

dissolving said gaseous chlorine, chlorine dioxide, and steam in water to produce a product stream.

2. A method according to claim 1 including the step of mixing said product stream with an aqueous moiety whereby said chlorine and chlorine dioxide in said product stream react with contaminants in said aqueous moiety to oxidize and/or disinfect said contaminants.

3. A method according to claim 1 including the step of selecting hydrochloric acid as said inorganic acid.

4. A method according to claim 3 including the step of establishing the concentration of hydrochloric acid between 5% and 40% by weight.

5. A method according to claim 1 including the step of establishing an initial concentration of from 200 to 700 grams per liter of alkali metal chlorate in said aqueous solution of alkali metal chloride.

6. A method according to claim 1 including the step of maintaining said alkali metal chlorate solution and said inorganic acid at a temperature between 20°C and 60°C in order to produce in said gaseous product stream chlorine/chlorine dioxide ratios greater than 2.5.

7. A method according to claim 5 including the step of selecting sodium chlorate as said alkali metal chlorate.

8. A method according to claim 1 including the step of using a horizontal reactor wherein said aqueous solution of alkali metal chlorate flows through said reactor and said inorganic acid is introduced into said flow of aqueous solution of alkali metal chlorate in a manner to permit said chlorine, chlorine dioxide and steam to rise through said aqueous solution of alkali metal chlorate at a several locations along said flow.

9. A method according to claim 8 including the step of establishing said flow of alkali metal chlorate successively through a plurality of individual horizontal reactors and adding additional inorganic acid to said flow prior to each successive reactor.

10. A method according to claim 8 including the step of withdrawing a product stream containing chlorine, chlorine dioxide and steam from each of said reactors.

11. A method according to claim 9 including the step of allowing reaction of said alkali metal chlorate and said inorganic acid to proceed substantially to completion.

12. A method according to claim 9 including the step of flowing said aqueous alkali metal chlorate through from one to twelve individual reactors arranged in series.

13. A method according to claim 8 including the step of introducing said inorganic acid into said flow of alkali metal chlorate at from three to twelve separate locations spaced along a longitudinal axis of said reactor.

14. A method for producing a gaseous mixture of chlorine dioxide and chlorine comprising the steps of:

establishing a volume of an aqueous solution of sodium chlorate at a temperature between 20°C and 95°C;

introducing hydrochloric acid at several locations within said volume of said aqueous solution of sodium chlorate, said hydrochloric acid having a temperature between 20°C and 95°C;

permitting said hydrochloric acid to react with said aqueous solution of sodium chlorate causing bubbles of chlorine, chlorine dioxide and steam to rise through said aqueous solution of sodium chlorate;

collecting gaseous chlorine dioxide, chlorine and steam in a head space maintained over said volume of said aqueous solution of sodium chlorate; and

removing said gaseous product stream of chlorine, chloride dioxide and steam from said head space.

15. A method according to claim 14 including the step of producing a product stream by dissolving said gaseous product stream of chlorine dioxide, chlorine, and steam in water.

16. A method according to claim 15 including the step of mixing said product stream with an aqueous moiety whereby said chlorine and chlorine dioxide in said product stream react with contaminants in said aqueous moiety to, one of, oxidize and/or disinfect said contaminants.

17. A method according to claim 15 including the step of applying said product stream to one of, treat potable water or waste water.

18. A method according to claim 15 including withdrawing said product stream wherein the ratio of chlorine to chlorine dioxide is at least 1.5 to 1.

19. A method according to claim 1 including the step of maintaining said sodium chlorate solution and said hydrochloric acid at a temperature between 20 degrees C and 60 degrees C in order to produce in the gaseous product stream chlorine/chlorine dioxide ratios greater than 2.5.

20. A method according to claim 14 including the step of maintaining the partial pressure of chlorine dioxide at a level below 150 mm Hg by a combination of one of or all of the steps of vacuum, dilution with chlorine, and dilution with steam produced in the generation of said gaseous chlorine, chlorine dioxide and steam.

21. A method according to claim 2 including the step of maintaining the partial pressure of chlorine dioxide at a level below 76 mm Hg.

22. A method according to claim 14 including the step of providing said hydrochloric acid at a concentration of from 5 to 40% by weight.

23. A method according to claim 14 including the step of establishing said volume of said aqueous solution of sodium chlorate with an initial concentration of sodium chlorate from 200 to 700 grams per liter.

24. A method according to claim 14 including the step of adding chloride ion to one of said aqueous solution of sodium chlorate, said aqueous solution of hydrochloric acid, or both in order to increase the ratio of chlorine to chlorine dioxide in said gaseous product stream.

25. A method according to claim 14 including the step of obtaining said chloride ion by recycling spent liquor from said method.

26. A method according to claim 14 including the step of using a horizontal reactor wherein said aqueous solution of sodium chlorate flows through said reactor and said hydrochloric acid is introduced into said flow of aqueous solution of sodium chlorate in a manner to permit gaseous products of reaction to rise through said aqueous solution of sodium chlorate at several of locations along said flow.

27. A method according to claim 26 including the step of using a horizontal reactor wherein said aqueous solution of sodium chlorate flows through said reactor and said hydrochloric acid is introduced into said flow of aqueous solution of sodium chlorate in a manner to permit gaseous products to rise through the resulting aqueous solution at a plurality of locations along said flow, thereby achieving a chlorine to chlorine dioxide ratio of greater than 2.5 in the product stream.

28. A method according to claim 26 including the step of establishing said flow of alkali metal chlorate successively through several individual horizontal reactors and adding additional hydrochloric acid to said flow prior to each successive reactor, thereby achieving a chlorine to chlorine dioxide ratio more than 1.5 and less than 4.

29. A method according to claim 26 including the step of establishing said flow of inorganic acid successively through several individual horizontal reactors and adding additional alkali metal chlorate to said flow prior to each successive reactor, thereby achieving a chlorine to chlorine dioxide ratio greater than 2.5.

30. A reactor for generating a gaseous mixture by reacting an aqueous solution of an alkali metal chlorate and an inorganic acid comprising:

a first horizontally disposed reactor section having a first end adapted to introduce said alkali metal chlorate and inorganic acid into said reactor section;

a second end of said reactor section having means to impound a volume of said aqueous solution of an alkali metal chlorate within said reactor with a gas space above said volume of said aqueous solution of an alkali metal chlorate;

means to introduce said inorganic acid at a plurality of locations along at least a portion of the length of said volume of said aqueous solution of an alkali metal chlorate;

means to withdraw gaseous reactant products from said gas space; and

collection means at said second end of said reactor section to collect waste liquor from said reactor section.

31. A reactor according to claim 30 wherein said means to introduce said inorganic acid is a diffuser disposed along the length of said volume of said aqueous solution of said alkali metal chlorate.

32. A reactor according to claim 30 wherein said reactor includes means to heat said aqueous solution of alkali metal chlorate and said inorganic acid before introduction into said reactor section.

33. A reactor according to claim 30 including means to maintain said reactor section at a constant temperature.

34. A reactor according to claim 30 wherein said reactor includes means to heat said aqueous solution of alkali metal chlorate and said inorganic acid as it flows from storage into said reactor section.

35. A reactor according to claim 30 wherein substantially all components of the reactor are designed to contain pressure of at least 180 psig.

36. A reactor according to claim 30 including means to use pressurized water to drive an ejector to create a vacuum to draw a mixture of chlorine dioxide, chlorine and steam into said water whereby said steam is condensed by said water and said chlorine dioxide and said chlorine are dissolved in said water.

37. A reactor according to claim 36 including an auxiliary tank connected to said reactor and said tank such that said water containing said dissolved chlorine dioxide and said chlorine are conducted to a tank wherein air separated from gaseous chlorine dioxide and chlorine can be safely vented and a solution of chlorine dioxide and chlorine dissolved in water can be withdrawn from said tank as a product stream.